A VOYAGE THROUGH THE SYSTEM
TRS-80 MICRO-COMPUTER FROM RADIO SHACK

by

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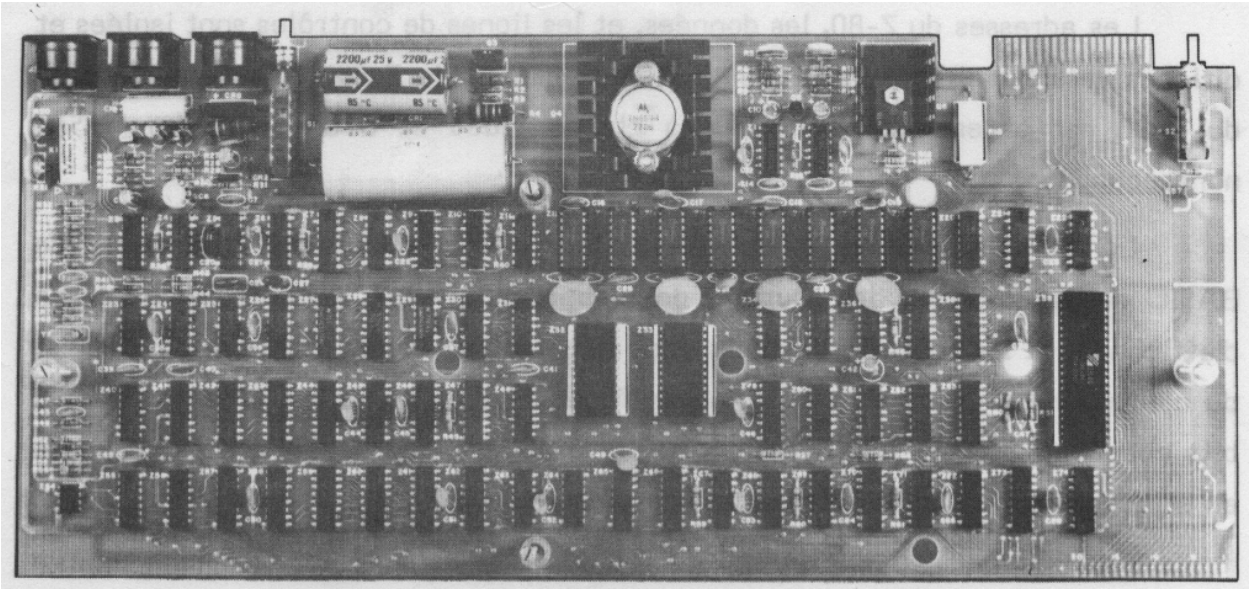

TRS-80 CONTROL PANEL/MOTHERBOARD

The new TRS-80 micro-computer system from Radio Shack brings together several features that together give the user the highest performance/price ratio achieved to date. The basic system, valued at $879.95, includes 4 components: the TRS-80 micro-computer, the 12" monitor, a power source, and the tape unit (tape recorder).

The TRS-80 micro-computer is housed in a rigid ABS plastic cabinet, whose appearance harmonizes with the "TRS-80 concept." At first glance, what may appear to be only a keyboard actually contains the entire micro-computer. Figure 3, page 7, shows us the functional diagram of the TRS-80 micro-computer.

The Z-80 microprocessor module was chosen for the TRS-80 micro-computer. The decision to use the Z-80 module was made after examining several existing central processing units.

After comparing the equipment required for the use of the different microprocessors, the current cost of the module, the efficiency of the machine language, and the availability of the prototype equipment, it quickly became apparent that the Z-80 was a winner in every point of view.

The Z-80's address, data, and control lines are isolated and directed to the different function zones in the Z-80. The input clock for the Z-80 is obtained from the video chain counter and has a period of 563 nanoseconds.

The 'ROM' (Read Only Memory) contains Radio Shack's Level I BASIC, keyboard support routines, screen display control, and cassette support routines. This passive memory is of the non-programmable type (i.e., non-erasable) and totals 4096 bytes of 8 bits each. Up to 12K bytes of 'ROM' passive memory can be supported using internal electrical terminals of the TRS-80.

The TRS-80 uses 'RAM' (Random Access Memory) dynamic random access memory for programs. This 'RAM' memory can be increased internally from 4K to 16K. All dynamic memory requires periodic refreshing so as not to lose information in memory.

The TRS-80 micro-computer takes advantage of the automatic refresh of the Z-80, which reduces work and reduces the additional circuits normally associated with 'RAM' high-speed dynamic memories to just a few integrated circuits.

The 53-key keyboard is full-size and of professional quality. The interface between the keyboard and the micro-computer is as simple as can be. Each key on the keyboard represents the crossing point on an 8 by 8 matrix. The input circuit of the matrix is activated by the lowest address of the 8 bits through a buffer collector circuit. The output circuit of the matrix is detected by a 'tri-state' inverter buffer circuit. By using

the software program, any key on the keyboard can be detected and decoded, allowing for complete keyboard coding at a modest price.

The logic for the control screen produces the video information and the synchronization signal to form 16 lines of 64 alphanumeric characters. This logic includes 1K words of 7-bit 'RAM' high-speed access memory, a countdown chain, the selected address of the 'RAM' memory, the USAsC II character generator, and the shift register. The Z-80 uses the 'RAM' high-speed access memory only if information must be read or displayed.

The data move instructions of the Z-80 simplify the write control programs. The countdown chain provides all the signals necessary to generate a synchronization signal, as well as the appropriate address for video information in the high-speed access memory and the clock for the points. The clock for the points controls the shift register which contains either a character coming from the character generator or graphical information coming from the graphic multiplexer.

Graphics in the Z-80 are displayed character by character. Alphanumerics are displayed as a 5 x 7 dot matrix in a 6 x 12 cell. When the highest-order bit of the screen 'RAM' has a logic value of 1, the cell is divided into a 2 x 3 graphic character. The BASIC routines for 'SET', 'RESET', and 'POINT' are converted from x and y coordinates into an execution program incorporating the TRS-80 graphics.

A standard 75-ohm video output is incorporated for connection to the monitor. (See page 6).

The interface chosen for the cassette is the best compromise between system reliability and minimum cost. Using a method similar to a floppy disk, the support programs for the cassette record one pulse for a logic 0 and two pulses for a logic 1. The support programs operate at 250 baud. In order to limit work, a relay is used for stopping and starting the cassette.

The regulated power source employs a closed-loop voltage regulator in the +5 volt and +12 volt section, providing a reliable and predictable voltage. In the -5 volt section, a Zener circuit was used because of the low current. The +5 volt and +12 volt sources have current limit circuits; in addition, the +5 volt source has overvoltage protection.

The step-down transformer is outside the computer because of its dimensions and thermal considerations.

To provide for memory expansion and the addition of peripheral units, an expansion socket has been provided (See page 6). The address and information, in addition to data input and output, writing and reading, input and output interruption—all these main channels are available on a 40-contact board at the back of the TRS-80. A cable can be plugged into the back and routed to a TRS-80 expansion unit, a floppy disk, and/or a printer.

The TRS-80 display screen is a scanning unit with a bandwidth exceeding 6 MHz. It has a 75-ohm input so that it can be used with the TRS-80 or with any piece of equipment having a standard video output. The video input signal is isolated from the cathode ray tube circuit by an optical isolator. This offers an excellent margin of protection for the operator. See Fig. 3.

The tape unit (tape recorder) included with the TRS-80 micro-computer system is a standard audio tape recorder. See fig. 3.

Radio Shack Level I BASIC

This BASIC is a floating-point BASIC with support for cassette, graphics, and some string options. The numerical limit is approximately 10^{+38}, with a precision of 7 digits (6 displayed).

The supported BASIC commands are: NEW, LIST, RUN, CONT, REM, LET (optional), FOR-NEXT-STEP, GOSUB-RETURN, STOP, END, GOTO, IF-THEN, INPUT, ON...GOTO, ON...GOSUB, PRINT, DATA, READ, and RESTORE. Cassette commands are CLOAD and CSAVE for

complete programs and INPUT# and PRINT# for data files.

Other supported BASIC commands are: INT(x), TAB(x), ABS(x), RND(x), +, -, *, /, >, <, =, and MEM.

Several other commands have been added and this enhances the value of Radio Shack Level I BASIC. These are:

CLS - Clears the screen

SET (x,y) - Projects a graphic segment at (x,y), (x = 0-127, y = 0-47)

RESET (x,y) - Erases a graphic segment at (x,y)

POINT (x,y) - Command returns a 1 if point (x,y) is active, a 0 if the point is non-active

PRINT AT (x) - Direct control over the cursor (x = 0 to 1023)

Allocated numerical variables are from A to Z. A one-dimension table A(X) is available. Strings A$ and B$ each have a maximum possibility of 16 characters.

Several programs written in BASIC are currently available on cassette, including blackjack, backgammon, accounting, payroll, math tutoring, and personal finance.

At Tandy Advanced Products, engineers and programmers work on the development of new products to improve the performance of the TRS-80 micro-computer. New software applications include: general ledger, accounts receivable, inventory control, music theory, tutoring program, and space war.

Other peripheral equipment (hardware) are available, such as: printers, floppy disks, expansion unit (for additional PC cards), serial circuit I/O/Modems, and additional memory.

In addition, an advanced software system, such as BASIC II, editor/assembler, disk operation system, and compiler are already in preparation.

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INTERFACE SPECIFICATIONS

Cassette

Input level to computer	2V peak to peak with a minimum impedance of 360K ohms
Output level from computer	800 mV peak to peak at 1K ohm
Remote switch	0.5 A max. at 6 VDC

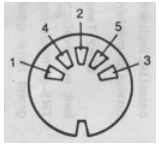
DIN Jack Assembly (see figure 1)

1. Remote Switch
2. Common
3. Remote Switch
4. Computer Input
5. Computer Output

Video
DIN Jack Assembly (see figure 1)

1. 5 VCC at 50 ma
1. not used
2. not used
3. Video signal, 1.4V peak to peak, negative sync 0.4V, 75 ohms
4. Common

Figure 1. DIN Jack Connections for Cassette and Video (viewed from the back of the keyboard).



DESCRIPTION OF EXPANSION CONTACTS
(see figure 2)

PIN NO.	SIGNAL CODE	DESCRIPTION
1	RAS*	Row Address Strobe Output for 16-Pin Dynamic Rams
2	SYSRES*	System Reset Output, Low During Power Up Initialize or Reset Depressed
3	CAS*	Column Address Strobe Output for 16-Pin Dynamic Rams
4	A1Ø	Address Output
5	A12	Address Output
6	A13	Address Output
7	A15	Address Output
8	GND	Signal Ground
9	A11	Address Output
10	A14	Address Output
11	A8	Address Output
12	OUT*	Peripheral Write Strobe Output
13	WR*	Memory Write Strobe Output
14	INTAK*	Interrupt Acknowledge Output
15	RD*	Memory Read Strobe Output
16	MUX	Multiplexor Control Output for 16-Pin Dynamic Rams
17	A9	Address Output
18	D4	Bidirectional Data Bus
19	1N*	Peripheral Read Strobe Output
20	D7	Bidirectional Data Bus
21	INT*	Interrupt Input (Maskable)
22	D1	Bidirectional Data Bus
23	TEST*	A Logic "Ø" on TEST* Input Tri-States AØ-A15, DØ-D7, WR*, RD*, IN*, OUT*, RAS*, CAS*, MUX*
24	D6	Bidirectional Data Bus
25	AØ	Address Output
26	D3	Bidirectional Data Bus
27	A1	Address Output
28	D5	Bidirectional Data Bus
29	GND	Signal Ground
30	DØ	Bidirectional Data Bus
31	A4	Address Bus
32	D2	Bidirectional Data Bus
33	WAIT*	Processor Wait Input, to Allow for Slow Memory
34	A3	Address Output
35	A5	Address Output
36	A7	Address Output
37	GND	Signal Ground
38	A6	Address Output
39	+5V	5 Volt Output (Limited Current)
40	A2	Address Output

NOTE: *means Negative (Logical "Ø") True Input or Output

To connect to the computer output, use AMP connector P/N 88103-1

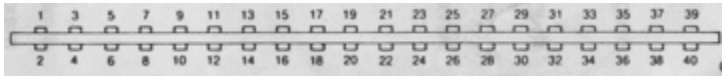


Figure 2. Mounting of contacts viewed from the back of the computer.